



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/665,309

09/22/2003

Chen-Hua Yu

252011-1670

5444

47390

7590

11/08/2004

THOMAS, KAYDEN, HOSTEMEYER & RISLEY LLP  
100 GALLERIA PARKWAY  
SUITE 1750  
ATLANTA, GA 30339

EXAMINER

LE, THAO X

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 11/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/665,309	YU ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Thao X Le	2814	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 September 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-41 is/are pending in the application.
- 4a) Of the above claim(s) 1-18 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 19-41 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Election/Restrictions*

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
  - I. Claims 1-18, drawn to a method of making semiconductor device, classified in class 438, subclass 618, 622-623, 627, 643, 652-653.
  - II. Claims 19-41, drawn to a semiconductor device, classified in class 257, subclass 750-759.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions Group I and Group II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product as claimed can be made by another and materially different process. For instant the insulating layers can be deposited on a carrying substrate, and then laminated onto the device substrate.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

4. During a telephone conversation with the Applicant's Attorney, Mr. Dan McClure, on 10/28/04 a provisional election was made without traverse to prosecute the invention of Group II, claims 19-41. Affirmation of this election must be made by applicant in replying to this

Art Unit: 2814

Office action. Claims 1-18 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 31-33 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. Claims 31-33, 39-40 recite the limitation "the width" in claim 31 and "the lining layer" in claim 33. There is insufficient antecedent basis for this limitation in the claim. Assuming the claim would read 'the hole is having a width of less than 950 <sup>0</sup>A', 'the trench is having a width of less than 1300 <sup>0</sup>A', and 'the structure further comprises a Ta and/or TaN lining layer'.

***Claim Rejections - 35 USC § 102***

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

10. Claims 19, 23, 26-30, 33 are rejected under 35 U.S.C. 102(e) as being anticipated by US PUB 2003/0227087 to Kakamu et al.

Regarding claim 19, Kakamu discloses a metal structure in fig. 31, comprising: a semiconductor substrate 101 [0088] with a conductor 131 [0019] thereon; an insulating layer 161 [0019], overlying semiconductor substrate 101 having a hole therein exposing the conductor 131; a conductive plug 201 [0090] substantially filling the hole and the underlying electrically connecting conductor 131; a silicon carbon-containing film 172 [101] overlying the insulating layer 161 and the conductive plug 201; a low dielectric constant layer 162 [0013] and [0025] overlying the silicon carbon-containing film 172; a trench in the low dielectric constant layer 162 and the silicon carbon-containing film 172; and a copper or copper alloy conductor 202 [0154] substantially filling the trench, electrically connecting the conductive plug 201.

Regarding claims 23, 26, 29, 30, 33 wherein the Kakamu discloses the structure wherein the conductor 131 is composed of metal [0019], wherein the silicon carbon-containing film 172 comprises silicon carbide (SiC) [101], wherein the low dielectric constant layer 162 comprises inorganic film, wherein the structure further comprises a Ta and/or TaN lining layer 191 [0090].

The process limitations “CVD or spin-on” in claim 29, do not carry weight in a claim drawn to structure. In re Thorpe, 277 USPQ 964 (Fed. Cir. 1985).

Regarding claim 27, Kakamu discloses the structure wherein the carbon content of the silicon-containing film 172 exceeds 20% (the molecular ratio of Si/C is about 70/30)

Regarding claim 28, Kakamu discloses the structure wherein the dielectric constant (k) of the low dielectric SiOC 162 [0022] is less than 3.0. Although the prior art does not specially disclose the claimed 'the dielectric constant (k) of the low dielectric 162 is less than 3.0', this feature is seen to be inherently teaching of that limitation, because the inherent material property of SiOC. Such property is disclosed in US 6803326 to Ahn, see abstract.

***Claim Rejections - 35 USC § 103***

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

12. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

13. Claims 20-22, 24, 34-35, 37-38, 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over US PUB 2003/0227087 to Kakamu et al in view of US 6566701 to Agarwal.

Regarding claims 20-21, Kakamu discloses the structure wherein the conductive plug 201 is metal copper [0090].

But Kakamu does not disclose the structure wherein the conductive plug comprises tungsten or metal silicide.

However, Agarwal reference discloses the conductive plug 34, fig. 9, can be Cu, W, or metal silicide, column 4 lines 58-67. At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to use the conductive plug teaching of Agarwal with Kakamu's device, because such material substitution would have been considered a mere substitution of art-recognized equivalent values, MPEP 2144.06.

Regarding claim 22, Kakamu discloses the structure having the semiconductor substrate  
101 [0088]

But, Kakamu does not disclose the substrate comprises silicon or silicon germanium.

However, the semiconductor substrate as discloses by Kakamu obviously comprising Si and Si/Ge, see also US 6635527 to Greco, column 2 lines 45-49.

Regarding claim 24, Kakamu discloses the structure, wherein the insulating layer 161 and be SiOC, fig. 31 or undoped silicate glass (USG) layer 252 [0090], fig. 9.

At the time of the invention was made; it would have been obvious to one of ordinary skill in the art to use the teaching of Kakamu to replace the SiOC layer with the layer USG, because such replacement would have been considered a mere substitution of art-recognized equivalent values, MPEP 2144.06

Regarding claims 34-35, as discussed in the above claims 19 and 20-21, the combination of Kakamu and Agarwal would disclose all the limitations of claims 34, 35.

Regarding claim 37, Kakamu discloses the structure wherein the carbon content of the silicon-containing film 172 exceeds 20% (the molecular ratio of Si/C is about 70/30)

Regarding claim 38, Kakamu discloses the structure wherein the dielectric constant (k) of the low dielectric SiOC 162 [0022] is less than 3.0. Although the prior art does not specially disclose the claimed 'the dielectric constant (k) of the low dielectric 162 is less than 3.0', this feature is seen to be obviously teaching of that limitation, because the inherent material property of SiOC. Such property is disclosed in US 6803326 to Ahn, see abstract.

Regarding claim 41, Kakamu discloses the structure further comprises a Ta and/or TaN lining layer 191 [0090].

14. Claims 25, 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over US PUB 2003/0227087 to Kakamu et al in view of US PUB 2002/0132471 to Engel et al.

Regarding claims 25, 31-32 Kakamu discloses the structure wherein the thickness of the silicon carbon-containing film 172 and the width of the hole and the trench having general thickness, fig. 31.

But Kakamu does not disclose the thickness of the silicon carbon-containing film 172 is less than 500 <sup>0</sup>A, the hole having the width less than 950<sup>0</sup>A, and the trench having the width less than 1300 <sup>0</sup>A.

However, Engel reference discloses the silicon carbon-containing film 3 is less than 500 <sup>0</sup>A, fig. 1, [0016]. Accordingly, it would have been obvious to one of ordinary skill in art to use the SiC thickness teaching of Engel and Kakamu in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by



routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

15. Claims 36, 39-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over US PUB 2003/0227087 to Kakamu and US 6566701 to Agarwal as applied to claim 34 above and further in view of US PUB 2002/0132471 to Engel et al.

Regarding claim 36, 39-40, Kakamu discloses the structure wherein the thickness of the silicon carbon-containing film 172 and the width of the hole and the trench having general thickness, fig. 31.

But Kakamu does not disclose the thickness of the silicon carbon-containing film 172 is less than 500 <sup>0</sup>A and the hole having the width less than 950<sup>0</sup>A, and the trench having the width less than 1300 <sup>0</sup>A.

However, Engel reference discloses the silicon carbon-containing film 3 is less than 500 <sup>0</sup>A, fig. 1, [0016]. Accordingly, it would have been obvious to one of ordinary skill in art to use the SiC thickness teaching of Engel and Kakamu in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

Art Unit: 2814

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Thao X. Le  
01 Nov. 2004



LONG PHAM  
PRIMARY EXAMINER